# *Fundamental Research*

# *Bio-Info-Micro Interface Program*

*1 November, 2000*

**Dr. Delores M. Etter**

**Deputy Under Secretary of Defense (Science & Technology)**

# Mission

*. . . to ensure that the warfighters today and tomorrow have superior and affordable technology to support their missions, and to give them revolutionary war-winning capabilities.*

Office of the Deputy Under Secretary of Defense for Science and Technology

# Defense Science and Technology

# Revolutionary Capabilities

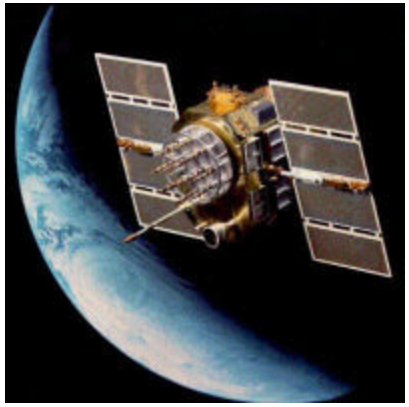
***Stealth***

***Adaptive Optics and Lasers***

***Night Vision***

DoD S&T

***Phased Array Radar***



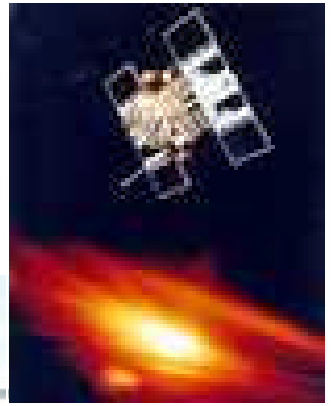
***GPS***

# Strategic Environment

## Global US Interests

*Political - Economic - Humanitarian*

## Globalization of Technology



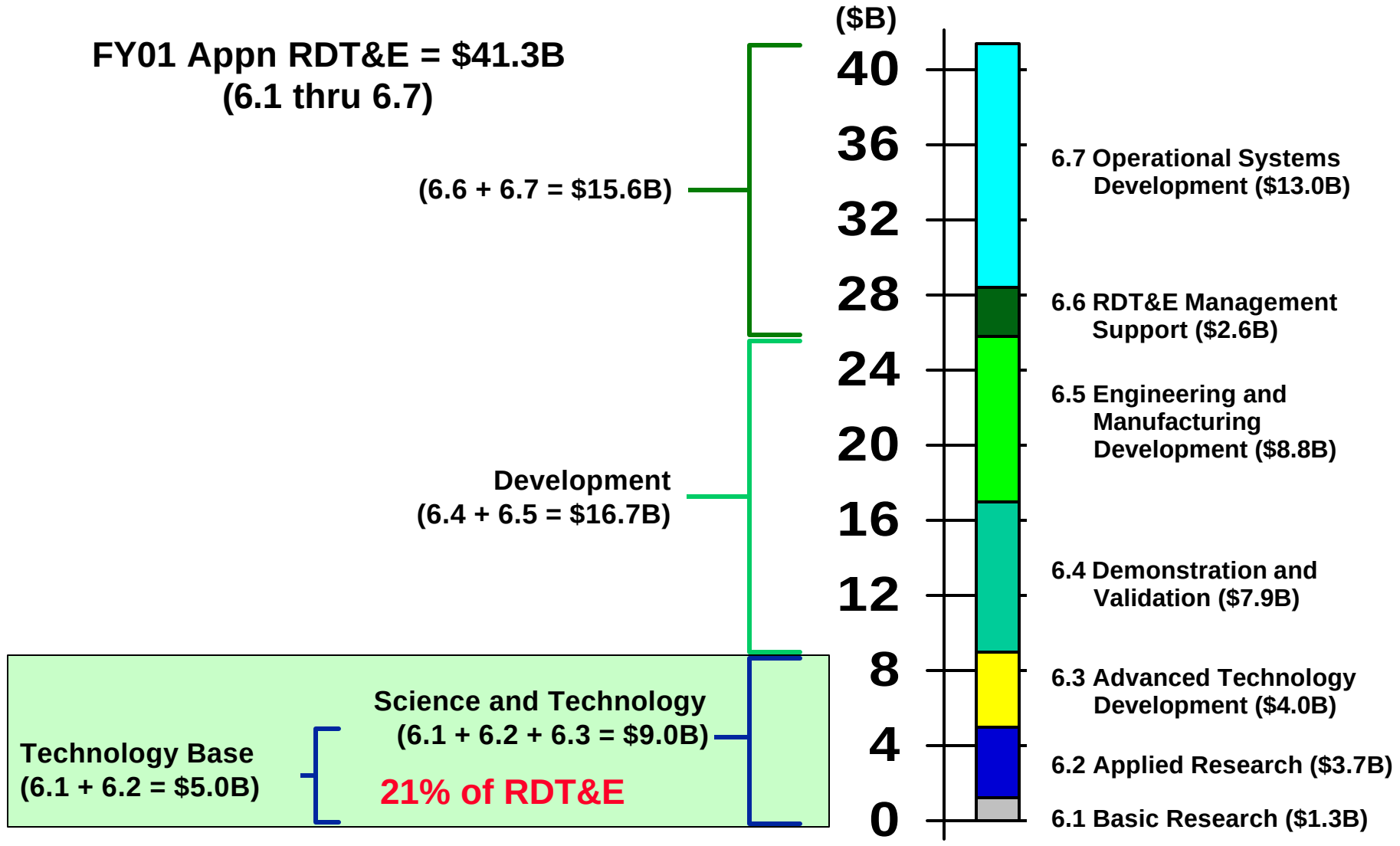
## Asymmetric Threats

*In any domain - Air, Land, Sea, Space or Information*

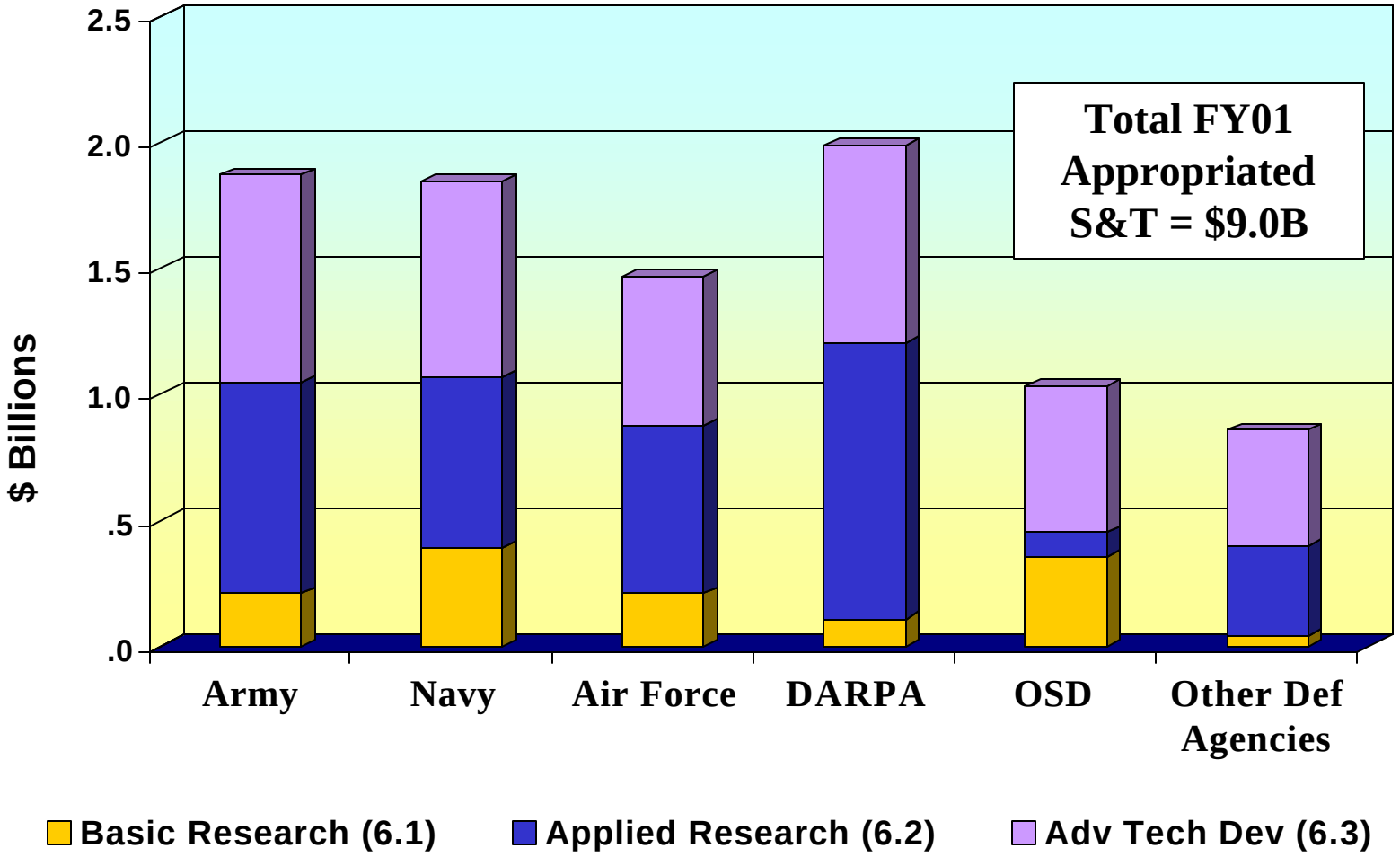
# Challenges for DoD Science & Technology

- Technical Challenges Include:
  - Systems that are:
    - Smaller
      - Require Less Power
    - Smarter
      - Software Intensive Systems
- Non-Technical Challenges:
  - Funding Commitment
  - Strength of Science & Engineering Workforce

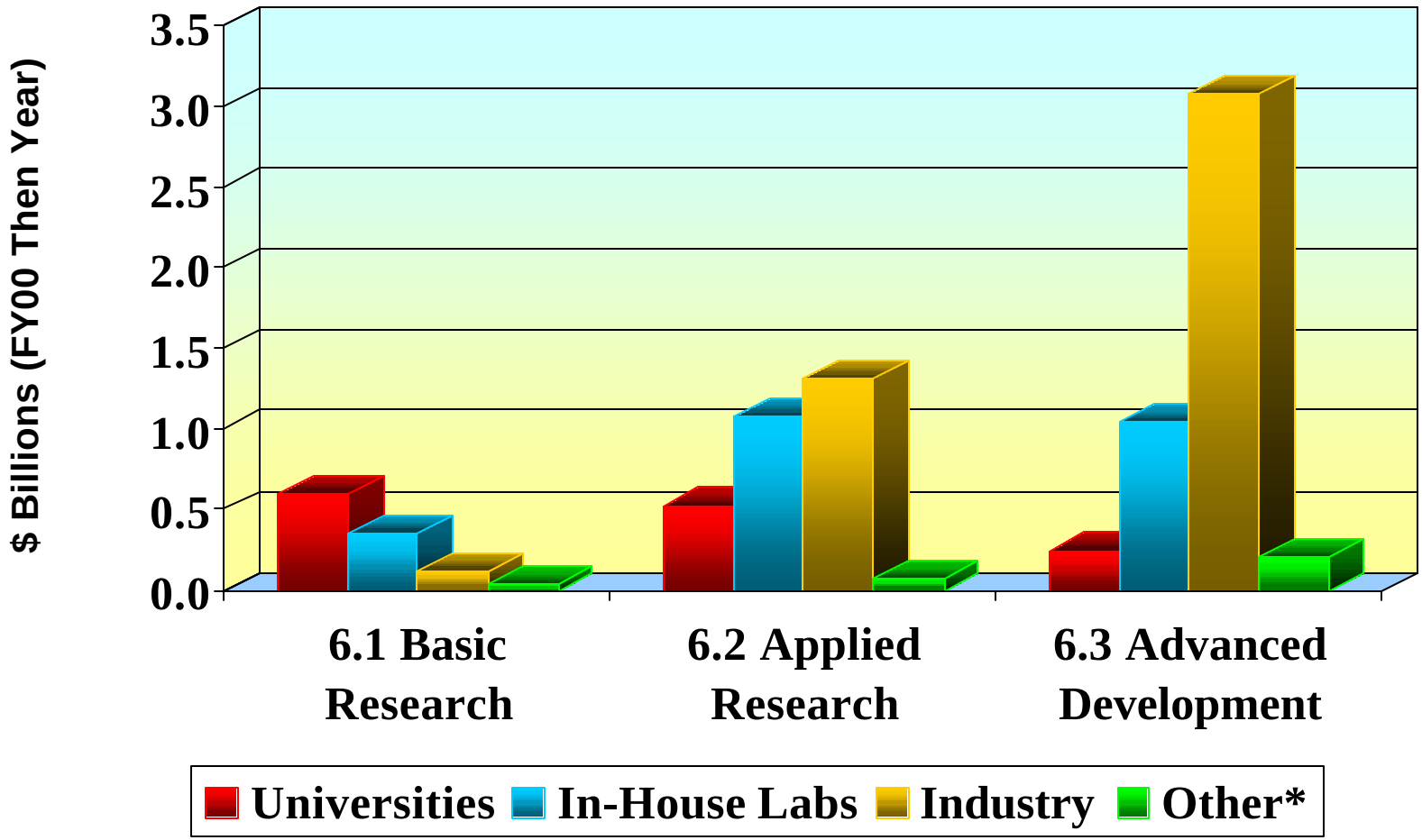
# FY01 Appropriated RDT&E



# DoD S&T Investment



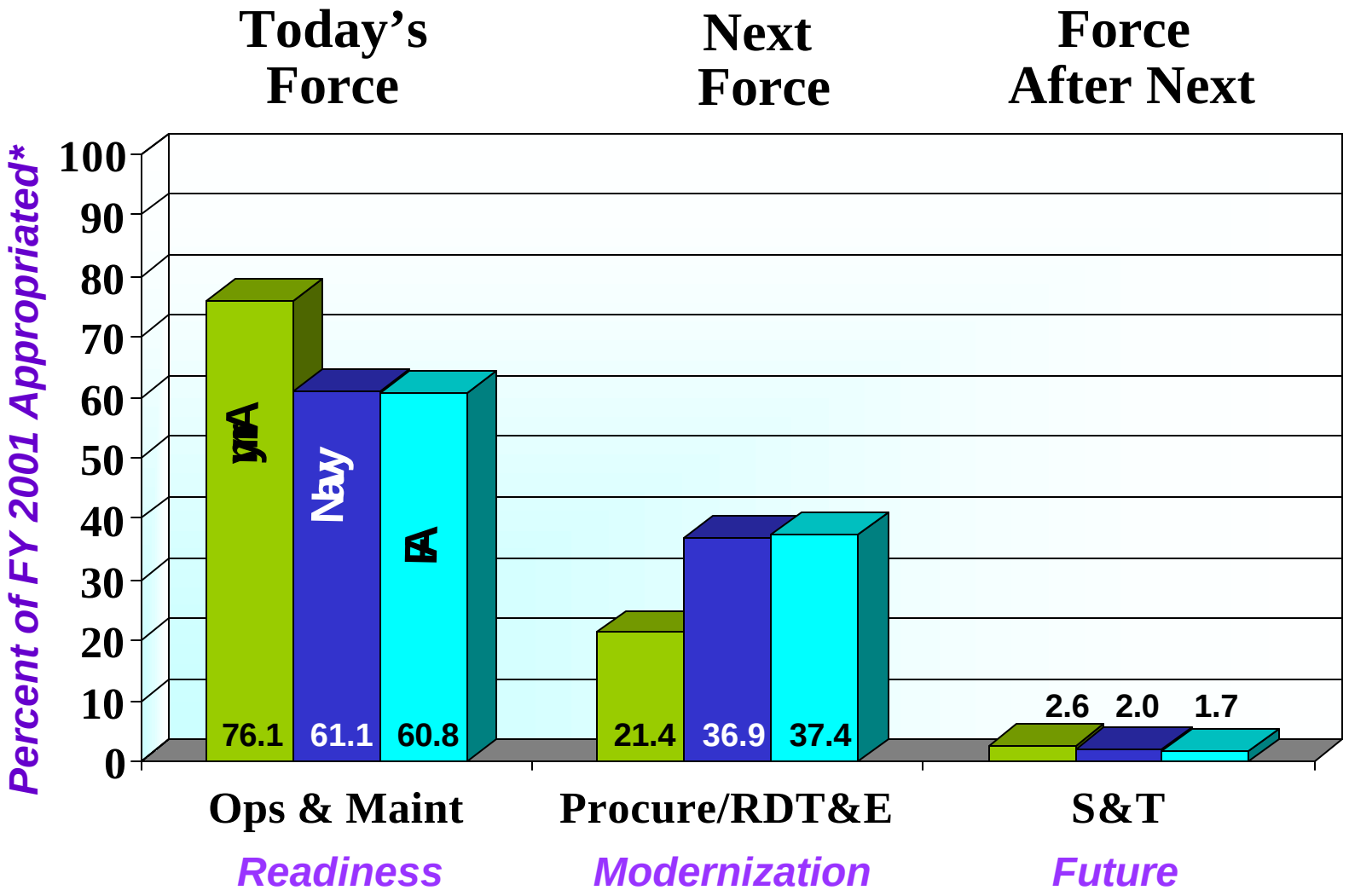
# Recipients of DoD S&T Funds



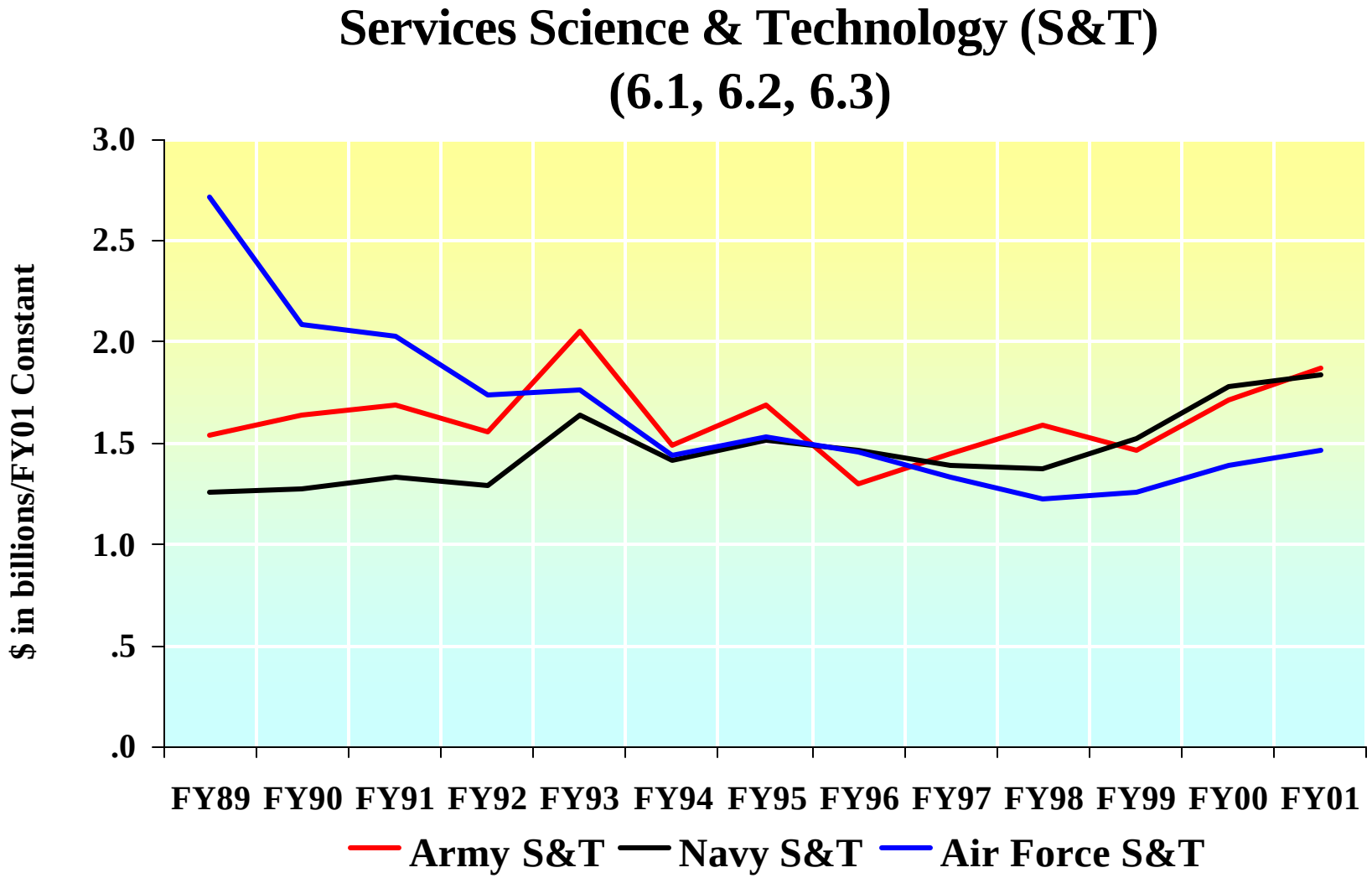

***Includes non-profit institutions, State & local govt., & foreign institutions**

Source: National Science Foundation Report, Volume 48 (FY 2000)

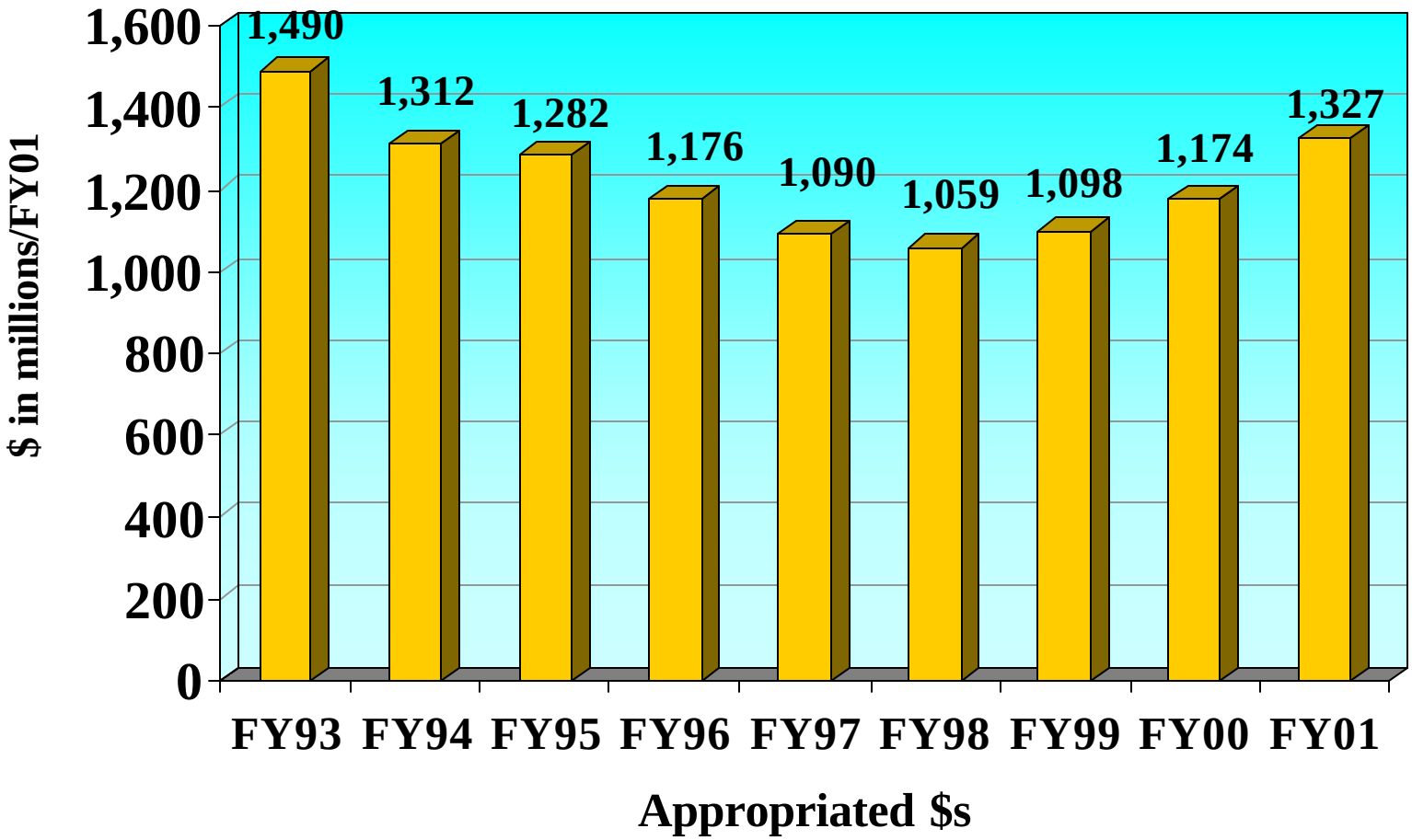
# Technology Perspectives
# FY01 Appropriated



# Service Investment in Science & Technology



# DoD 6.1 Basic Research



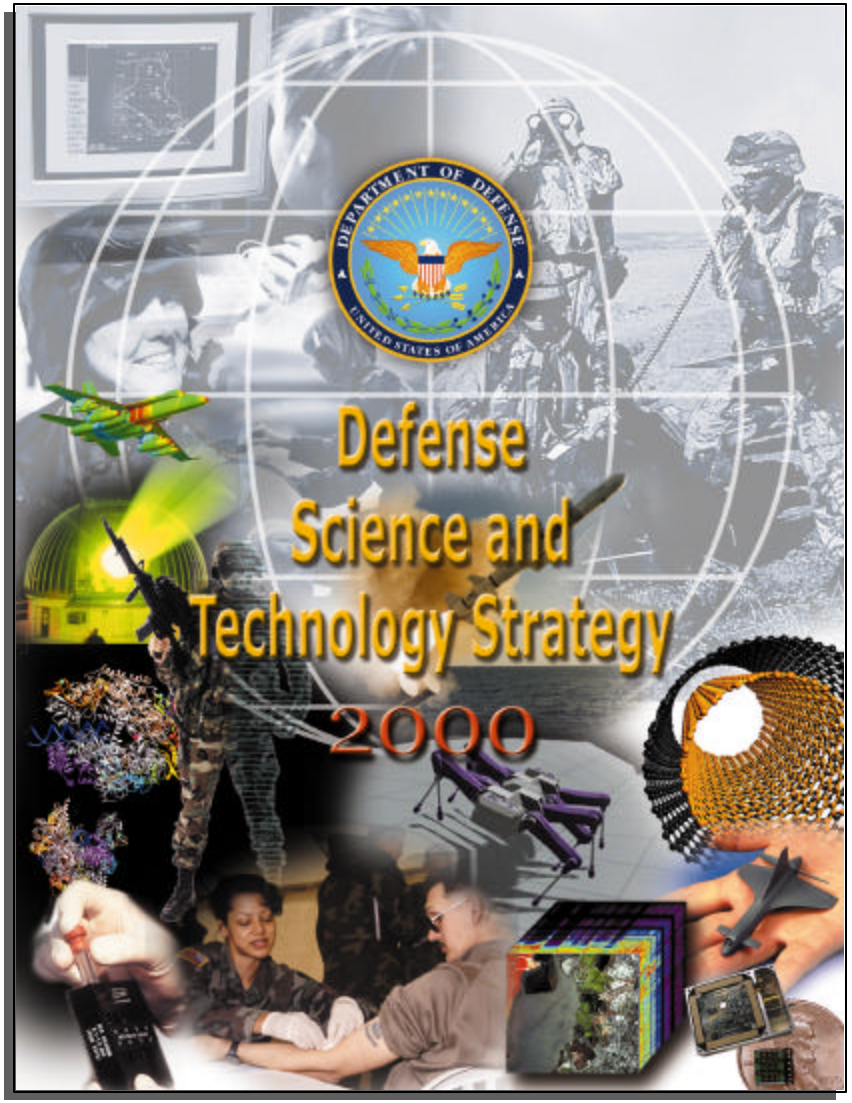

**Basic Research funding down over $163M (~10%) since 1993 after adjusting for inflation**

# FY98 DoD Percentage of Federal Research Funding to Universities

| | |
|---|---|
| All Engineering | 38% |
| Aeronautical Engineering | 42% |
| Astronautical Engineering | 22% |
| Chemical Engineering | 14% |
| Civil Engineering | 11% |
| Electrical Engineering | 71% |
| Mechanical Engineering | 63% |
| Metallurgy & Metals | 44% |

Source: NSF Federal Funds for R&D Data 31Jan00

# Defense S&T Strategy 2000



# The Department's S&T Components

- Army - Transformation to a 21st century force:
  - Lighter, Mobile, Agile, more Lethal and more Survivable while reducing Logistics Demands
  - Strategic Research Objectives
- Navy - Innovation that will provide Technology-Based options:
  - Future Naval Capabilities
    - autonomous operations, capable manpower, decision support systems, expeditionary logistics, information distribution, littoral antisubmarine warfare, missile defense, organic mine countermeasures, platform protection, time critical strike, total ownership cost reduction, and warfighter protection

# The Department's S&T Components cont

- Air Force - Aerospace Expeditionary Force:
  - Core Competencies: aerospace superiority, information superiority, rapid global mobility, agile combat support, precision engagement, and global attack.
  - Integrated Technology Thrusts: space superiority, information dominance, agile combat support, aircraft sustainment, training for warfighting, and precision strike.

# The Department's S&T Components cont

- DARPA - Technical Innovation in Support of National Security:
  - Solve National-level problems
  - Enable Operational Dominance
  - High-Risk, High-Payoff Technology Development and Exploitation

# The Department's S&T Components cont

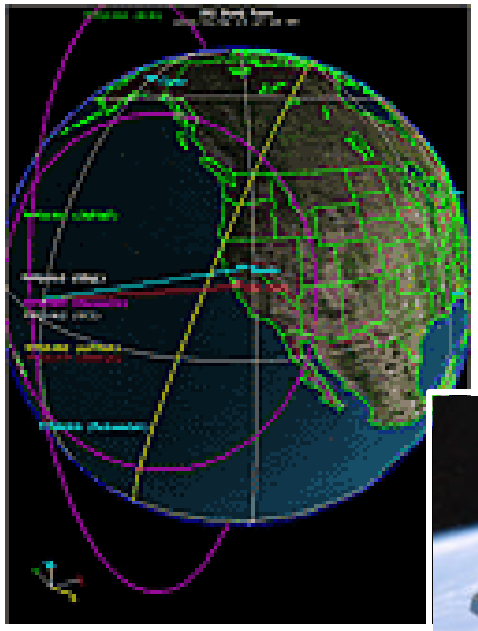
- Defense Threat Reduction Agency - Weapons of Mass Destruction:
  - Chemical and Biological detection technologies, physical protection systems, and medical countermeasures

- Ballistic Missile Defense Organization -
  - Theater Missile Defense, National Missile Defense, and Advanced Ballistic Missile Defense technologies

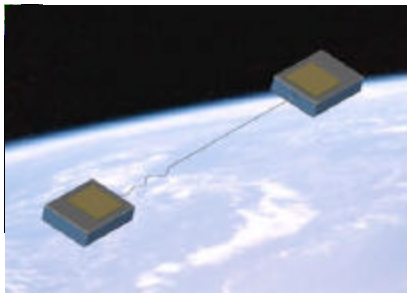
# DUSD (S&T) Priorities

- Basic Research
- Five Focus Areas
  - Chemical & Biological Defense
  - Information Assurance
  - Hardened & Deeply Buried Targets
  - Smart Sensor Web
  - Cognitive Readiness
- Cross Cutting Initiatives
  - Software Intensive Systems
  - High Performance Computing
  - Modeling and Simulation
- Technology Transition/Watch/Exposition
- World Class Laboratories

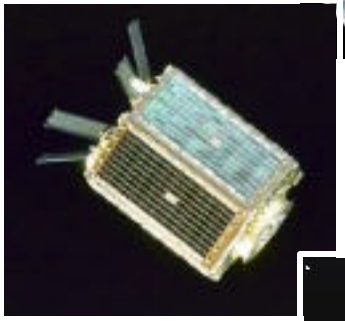
# Basic Research: Micro Satellites

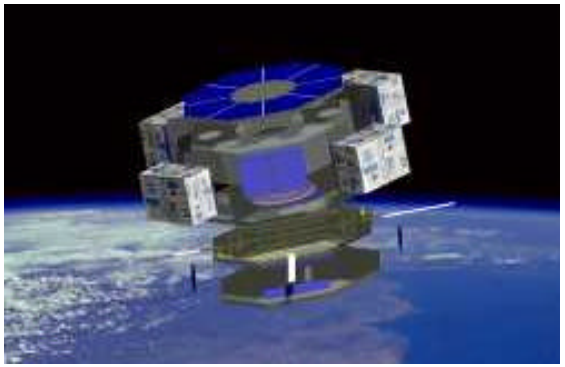


**Picosatellites**
**< 1 Kilogram**



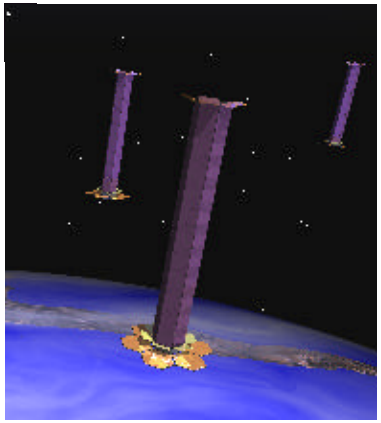
**Small Satellites**
**100-1,000 Kilograms**



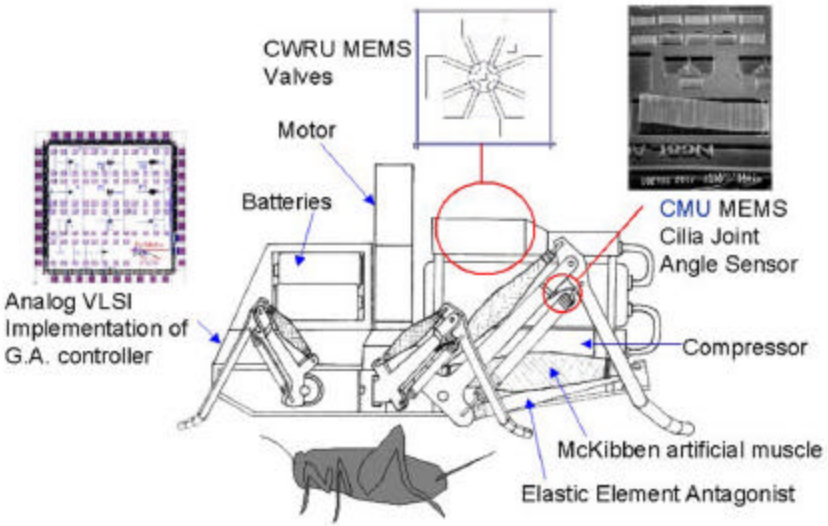
**Nanosatellites**
**1-10 Kilograms**

**Microsatellites**
**10-100 Kilograms**

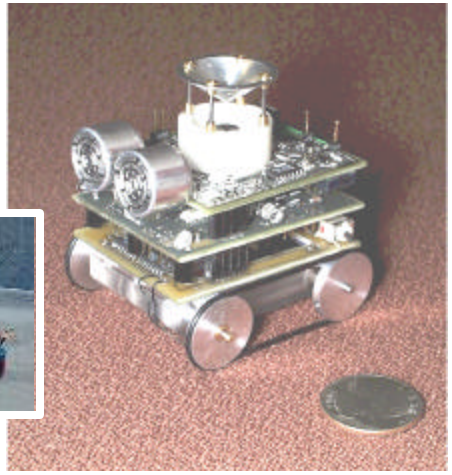


# Basic Research: Micro Robotics

***Cricket Micro-Robot***

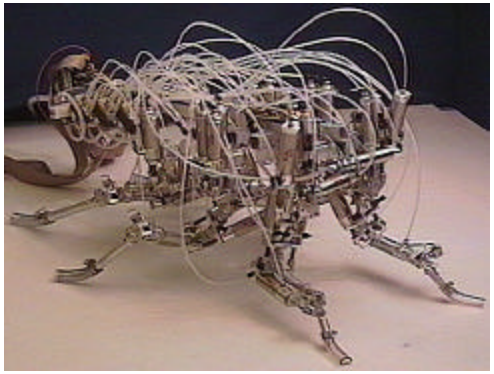



***Millibots***

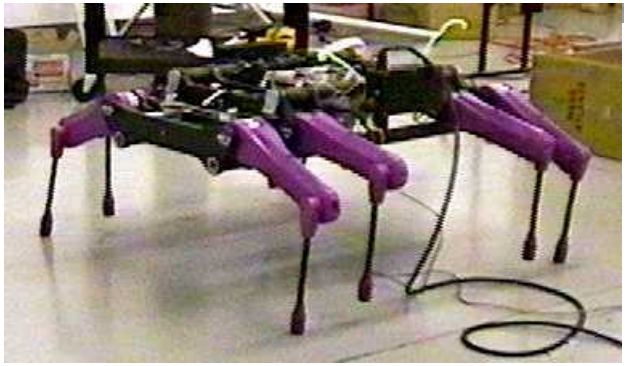


***Mini Flail***

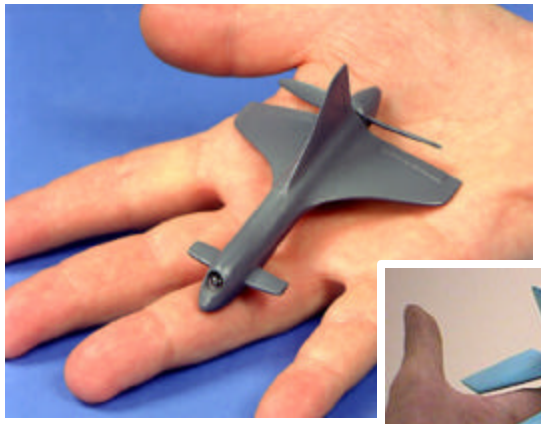
***Robot III***



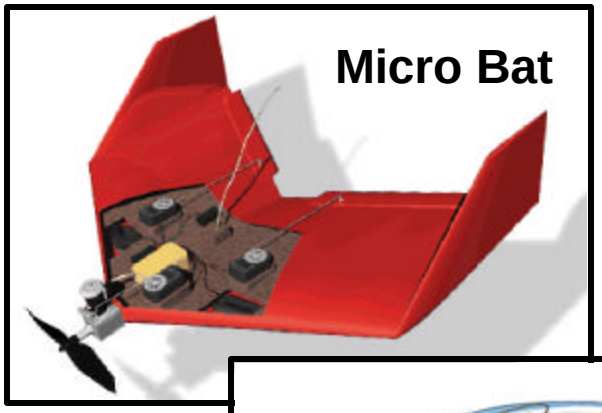
***K²T***

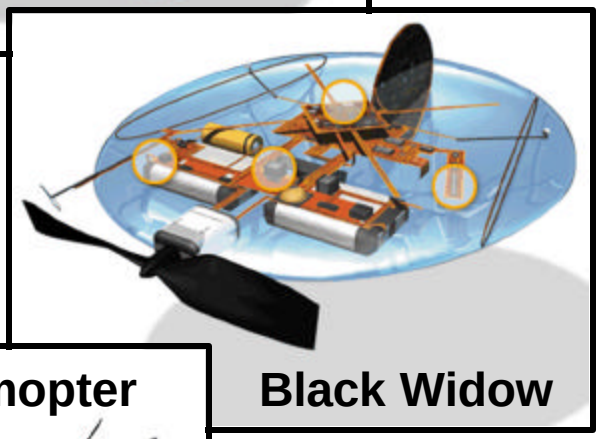


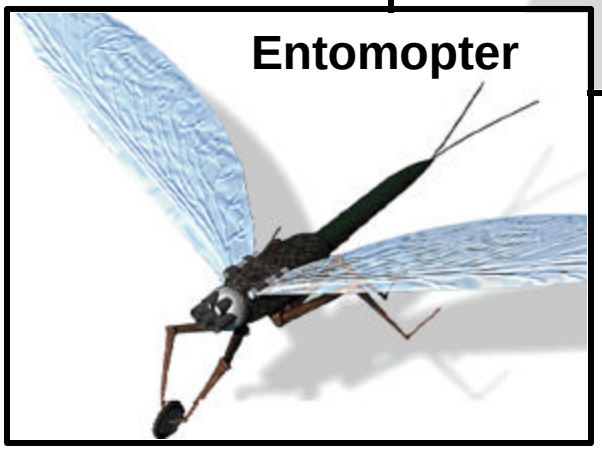
# Basic Research: Micro Air Vehicles

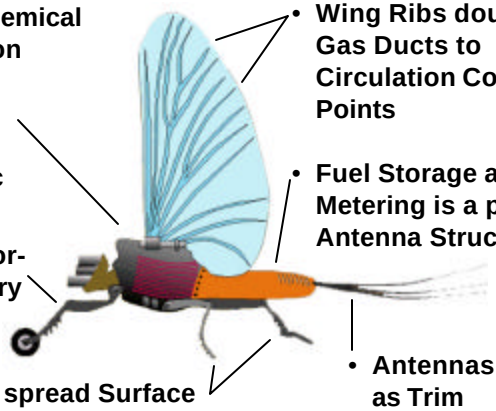


**MAVs**
***(3.5 in. and 6 in. models)***



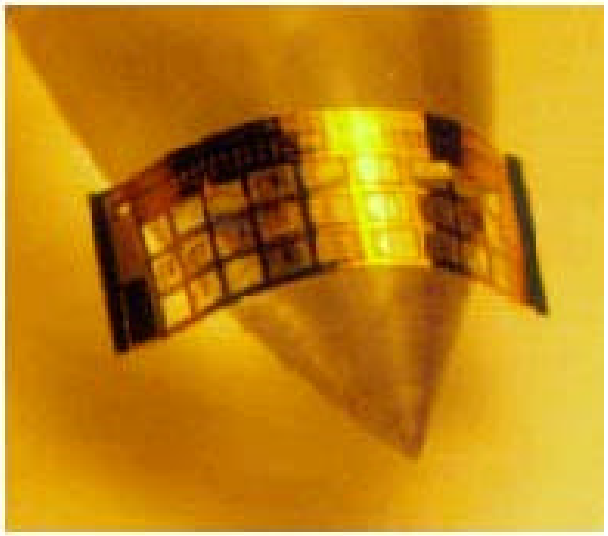



- Exoskeletal Chemical Muscle Reaction Chamber
- Exhaust Ports
- Wing Hinges
- Thermoelectric Generator
- Intensity Sensor-Actuated Trinary Steering
- Wing Ribs double as Gas Ducts to Circulation Control Points
- Fuel Storage and Metering is a part of Antenna Structure
- Antennas double as Trim Stabilizers
- Inflight, widely spread Surface Locomoters provide Anti-Roll Inertia with auxiliary fuel storage (mass) in legs/feet.

# Basic Research: Smart Materials & Structures

**Materials and structures that adapt to changes in the environment.**

- **Elastic active materials**
- **Smart skins and coatings**
- **Distributed sensors and actuators**
- **Armor materials by design**
- **Adaptive structures**

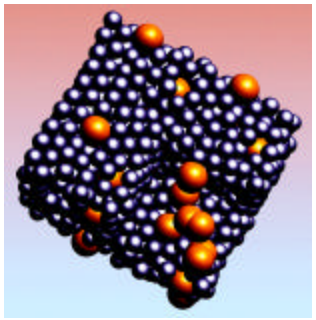


Flexible Sensor Skin

## DoD Applications:

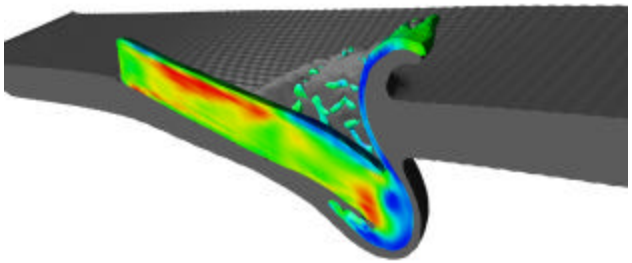
- **Ultraquiet submarines,**
- **adaptive flight control,**
- **vibrational control,**
- **advanced stealth,**
- **armor materials**

# Impact of Software, HPC and M&S



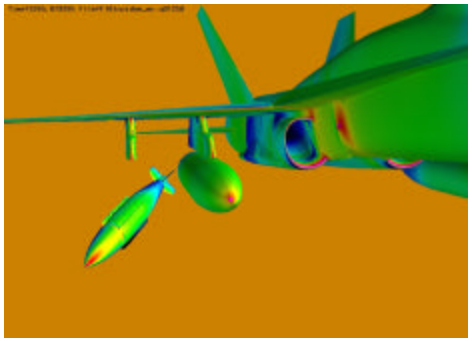
**Basic Research**

**Simulating High-Energy Density Rocket Fuels**



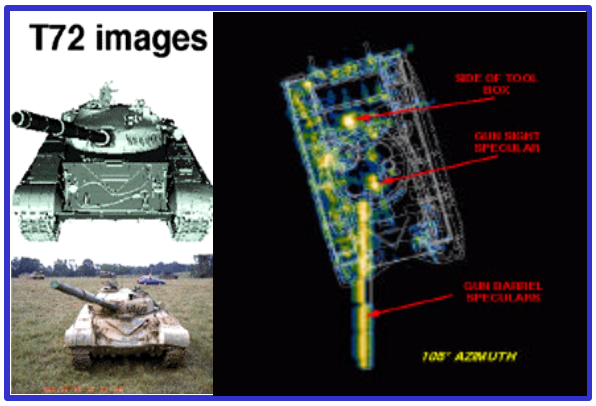
**Advanced Technology**

**Armor and Projective Design**



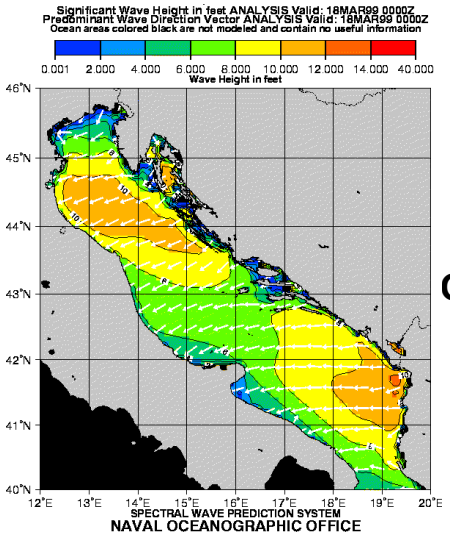
**Developmental T&E**

**Support of Aircraft-Store Compatibility and Weapons Integration**




**Intelligence**

**Radar Cross-Sections Predictions**




**Operations**

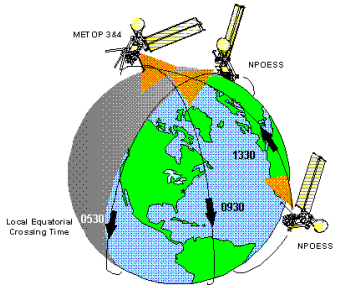
**Ocean/wave forecasting**

# Technology Transition/Watch/Exposition

**Stable, Long Term Investment**

***Service Labs***

**Expanded Resource Base**




***Interagency***

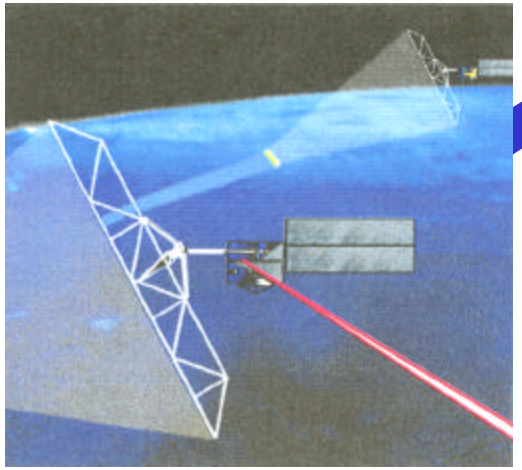
**New Ideas, Knowledge**

***Universities***

***Industries***

**Maximum National Security Payoff**

***DARPA***



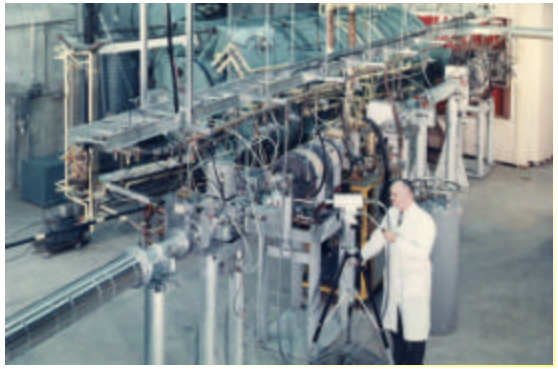
**High Risk, High Payoff**

***International***

**Coalition Capability**

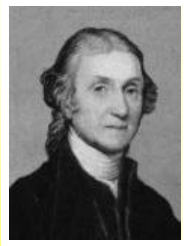
**Innovation, Transition**

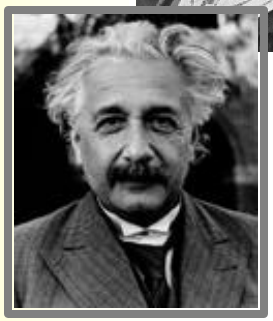
# World Class Laboratories



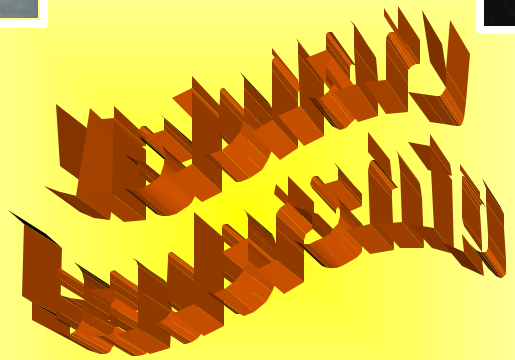
***State-of-the-Art Facilities***

***Outstanding People***





***Challenging Problems***



***Strong Partnerships***

*Technical Superiority is Critical for National Security.*

*In peace, it provides deterrence;*
*In crisis, it provides options;*
*In war, it provides an edge.*